

# Laser Raman Spectroscopy for Waste Tank Characterization

*Speeding up remediation safety studies*

**L**arge underground tanks of mixed chemical and high-level radioactive wastes at the DOE site in Hanford, Wash., must be characterized before remediation begins. Plans call for removing core samples from the tanks to a hot-cell laboratory for analysis, but in-tank characterization would be preferable. We are developing tools based on Raman spectroscopy for efficient chemical characterization of tank contents. Raman spectroscopy will be used to spatially characterize target species on the surfaces of tank core samples and on salt-cake surfaces in the tanks themselves. A Raman probe in a cone penetrometer will be used to obtain chemical profiles within tank sludges and salt cakes.

## A powerful tool in harsh environments

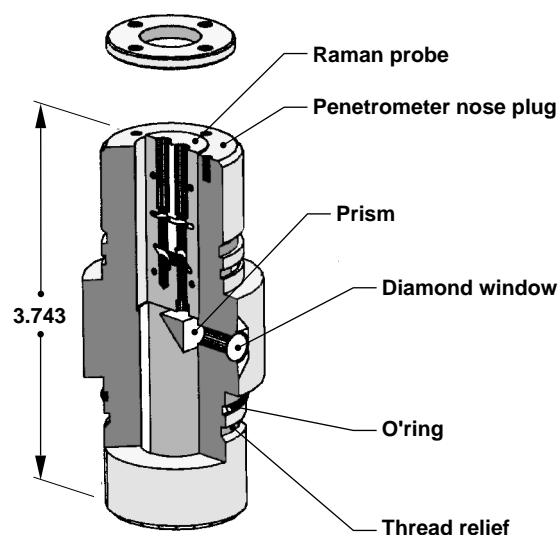
The more than one hundred million gallons of mixed wastes held in 177 underground storage tanks at Hanford are extremely heterogeneous. Before the wastes can be retrieved, treated, and disposed of, safety concerns require that each tank be extensively and quickly characterized to identify the chemical and radioactive composition and the physical characteristics of the wastes it contains.

### APPLICATIONS

- Analyze important tank waste constituents
- Analyze surfaces with spatial chemical resolution
- Adaptable cone penetrometer for in-tank and subsurface characterization
- Reduce worker exposure in safety surveys

Raman spectroscopy identifies inorganic and organic chemicals by means of their vibrational spectra. We are collaborating in developing and testing fiber-optic laser Raman techniques for deployment in hot cells and waste tanks at Hanford. Raman spectroscopy can identify many key tank constituents, such as nitrates, nitrites, ferri- and ferrocyanides, and chelating agents. Single-

point fiber-optic probes, which interrogate a sample one point at a time, have been successful in identifying key constituents such as nitrates in simulated tank samples.



The steel LLNL Raman probe assembly threads into the nose cone and pipe of a standard cone penetrometer. The probe fits inside the assembly, protected from the penetrometer pressure loading and from the harsh waste tank contents.

Cone penetrometers offer a faster, safer, and more cost-effective alternative to removing tank core samples for laboratory analysis. A cone penetrometer is being planned for in-tank application at Hanford. Probes suitable for use in penetrometers already exist for characterizing tank waste porosity, density, temperature, and electrical conductivity. Raman probes would provide crucial additional chemical-composition measurements.

**Availability:** The technology is available now. We are looking for industrial partners with whom to further develop and apply our advanced sensor technology.

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